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June 14, 2023

Tri-State Steelheaders
216 North Roosevelt Street
Walla Walla, Washington 99362

Attention: Brian Burns and Morgan Morris

Subject: SRFB Comment Response
Bridge to Bridge Phase 3
Lowden, Washington
File No. 11281-005-06

The following are requested clarifications received from the Salmon Recovery Fund Board (SRFB) based on their review of the updated Bridge to Bridge Phase 3 Final Design Drawings dated January 6, 2023. The comments were received via email from Tri-State Steelheaders on June 7, 2023, and summarized in this response letter. Requested clarifications are provided in bold text and the responses are provided below.

Explanation of Modification to Large Woody Material (LWM) Structures and Expected Outcomes

- **General Reasons for Modifications:**

  As SFRB noted, the most significant driver of design modifications from the previously approved Phase 3 design (July 2016) were the recent channel avulsions and changing channel conditions. Not only did the change in channel location motivate different structure locations and elements, witnessing the extent of channel changes within such a short time inspired a design shift away from proposed restoration based on present channel conditions to proposed restoration that can endure and enhance habitat through future channel avulsions and other long-term channel changes. We updated the restoration design to both respond to the recent channel changes and to make the habitat design more adaptable to long-term channel changes. We prioritized LWM structure locations where LWM will be activated at a range of flow events or where we anticipate to be increasingly activated as the channel continues to adjust.

  Additionally, we reduced LWM structure and log sizes, and placed a greater emphasis on mid-sized structures. We did this so LWM structures remain stable through channel adjustments and to increase the number of locations of LWM structures. This provides flexibility such that if one structure eventually becomes dry due to channel movement, others will remain engaged with active flow. Further, smaller logs are proposed to more closely mimic tree sizes in the area, improve constructability, and reduce environmental impacts (the original design included 45-foot long logs; the largest proposed size is now 35-feet).

In addition to the channel changes and anticipated future changes, we modified the design based on Tri-State Steelheaders and GeoEngineers' recent experience in the area. We prioritized structures that were successful during Phase 2 such as Apex Jams, Flow Deflection Jams, and Bank Rootwads. Additionally, GeoEngineers modified LWM structure design based on our experience on the Walla Walla River Forks Floodplain Restoration project for the Confederated Tribes of the Umatilla Indian Reservation. GeoEngineers and Tri-State Steelheaders modified the proposed LWM locations based on observed conditions during the 2022 site reconnaissance and combined recent experience. Proposed locations were refined based on hydraulic modeling and LWM stability calculations.

The modified restoration design provides a greater focus on habitat enhancement, and structures are designed to be activated at a larger range of flow events. The expected outcome of these modifications includes a more enduring, sustainable design that provides increased fish habitat in more frequent and variable locations and is more adaptable to the meandering channel.

- **Specific LWM Modification Reasoning:**
  - **Removal of terraces:** We removed terracing from the design largely because the thalweg is no longer against the banks where terracing was proposed and because we acknowledge channel grading may not be as enduring in this system as LWM structure placement. Removal of terracing also precluded the need for the large meander jams originally proposed, which served more of as bank erosion protection than as habitat enhancement. That allowed us to increase the number of other LWM structures and focus our efforts almost entirely on habitat enhancement.
  - **Removal of beaver dam analogs (BDAs):** We removed BDAs from the proposed design because Tri-State Steelheaders indicated limited success from BDA placement in side channels during Phase 2 in achieving the project goals. We determined this reach would benefit from additional wood over BDAs to achieve the increased complexity in side channels.
  - **Other LWM structure-specific modifications:** Increased number of Flow Deflection Jam and Apex Jam LWM structures were proposed since these structures have been installed and remain in place both in Phase 2 and other Walla Walla River projects in the area. Instead of two different sizes of Apex Jam structures, one mid-sized Apex Jam structure type is proposed. This both simplifies the design, reduces required log sizes, and increases the number of Apex Jam structures than can be built. Similarly, we decreased log sizes and the overall size of Flow Deflection Jams to more closely mimic tree sizes in the area and increase the number of structures to be placed. We also removed the Longitudinal Log structures since experience has shown that placing logs parallel to flow can increase velocities, and we replaced those with proposed Bank Rootwad structures since these provide similar habitat function and do not have this issue.

Wood Stability Analysis Explanation:

- LWM was analyzed for stability using the United States Department of Agriculture (USDA) Forest Service's (USFS) Computational Design Tool for Evaluating the Stability of Large Wood Structures (Rafferty 2016). Per Bureau of Reclamation (BOR) Large Wood Material Risk Assessment guidelines (BOR, 2014), a factor of safety (FOS) of 2.0 was used for buoyancy and a FOS of 1.75 was used for drag and moment force. We used the 100-year discharge to evaluate water depths and channel velocities affecting buoyancy and drag loads and to estimate stability. We calculated the balance of vertical, horizontal, and rotational forces for each of the six LWM structure types at representative locations using the maximum 100-year water depth and maximum channel velocity observed at representative cross sections within the project reach. Maximum velocity and maximum depth were used in LWM stability analyses such that the structure should remain in place even if the channel thalweg shifts to their location.

Other Specific Questions:

- **Change in LWM anchoring methods:** The decision to change from dead man ballast and pinning to soil overburden, piles and rope was due to the preference for materials that will not persist in the landscape. Based on recent experience, rope connections are easier and more efficient to construct than pinning using rebar. Revisions to anchoring methods are not expected to result in different habitat outcomes.
- **Depth of pile penetration:** Proposed total pile length is 18-feet minimum. The minimum embedment depth varies based on structure and is relative to the reference grade, which also varies by structure. As shown in the Typical Details, minimum pile depths are 12 feet below reference elevation (thalweg) for Flow Deflection Jams and 13.5 feet below reference elevation (average grade of adjacent gravel bar) for Apex Jams. As such, depths of pile penetration will vary by individual structure and location. Required depths are based on estimated pile scour and required anchoring based on LWM stability calculations. Pile scour was calculated using the HEC-18 Pier Equation (FHWA 2022) and resulted in total estimated pile scour of approximately 5 feet. Anchoring requirements and stability provided by piles were calculated per BOR Large Wood Material Risk Assessment guidance (BOR, 2014). Pile depths were increased from Phase 2 based on modifications to the LWM structures and to account for uncertainty related to channel changes.

References

Bureau of Reclamation (BOR). 2014. Pacific Northwest Region Resource & Technical Services Large Woody Material Risk Based Design Guidelines. September 2014. https://www.usbr.gov/pn/fcrps/documents/lwm.pdf.

Federal Highway Administration (FHWA). 2022. "Hydraulic Engineering Circular No. 18 (HEC-18) Evaluating Scour at Bridges 5th Edition." Federal Highway Administration, April.

Rafferty. 2016. Computational Design Tool for Evaluating the Stability of Large Wood Structures. Technical Note TN-103.1, U.S. Department of Agriculture, Forest Service, National Stream & Aquatic Ecology Center.

We trust that this letter meets your needs at this time.

Sincerely,
GeoEngineers, Inc.

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One electronic copy submitted